RADIO FREQUENCY IDENTIFICATION (RFID) BASED PLATE RECOGNITION FOR REGISTERED VEHICLE IN UMP

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ABSTRACT

Recent advances technology in world of computer resolve the difficulty of recognition. Based on technology of Radio-Frequency (RFID) has enhanced a project of plate recognition for registered vehicle specially proposed to Universiti Malaysia Pahang. The scopes of work is study and develop a passive tag RFID system in detection of RFID Reader from input to output composed of hardware, database development and software programming VisualBasic.Net. Method and implementation conducted by stages due to the system requirements needed. RFID Plate Recognition solves the problems of unauthorized vehicle entering campus of UMP without inspection and come out with a number of statistics vehicle check-in and check-out day-by-day.

Keywords: Knowledge Radio-Frequency Identification

ABSTRAK

Kemajuan teknologi terkini dalam dunia komputer menyelesaikan kesukaran pengiktirafan. Berdasarkan teknologi Frekuensi Radio (RFID) telah menghasilkan projek pengiktirafan nombor plat kenderaan yang berdaftar sebagai kenderaan sah di Univesiti Malaysia Pahang. Skp kerja merupakan kajian dan pembangunan sistem RFID beserta sistem tag pasif dalam pengesanan RFID Reader untuk input daripada perkakasan, pembangunan pangkalan data dan perisian perngaturcaraan VisualBasic.net.

Kaedah dan perlaksanaan yang dijalankan secara berperingkat mengikut proses-proses tertentu. Sistem ini menyelesaikan masalah kenderaan kampus yang dibenarkan memasuki kawasan Universiti Malaysia Pahang (UMP) tanpa pemeriksaan dan merangkumi statistik daftar kenderaan keluar dan masuk setiap hari.

Kata kunci: Pengetahuan Pengenalan Frekuensi Radio

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CHAPTER 1

1.0 INTRODUCTION

Radio-Frequency Identification (RFID) Based Plate Recognition for Registered Vehicle in UMP is one of project by the concept of RFID technology which is an automatic identification method, relying on storing and remotely retrieving data using its devices such as tags and responders.

1.1 Introduction

RFID for plate recognition is a system for process of check in and out of the main gate of Universiti Malaysia Pahang (UMP). It is design for only registered vehicle in UMP to make sure UMP staffs & students to get more secure and safety guarantees.

RFID basically is a Radio-Frequency Identification that use radio waves to transfer data from electronic tag, through some reader and attached to an object to be identified or to be tracked. It transmits the identity of an object wirelessly grouped under broad category of automatic identification technologies [1]. RFID contains three (3) main parts, firstly is the tag, second is the reader and last part is the antenna. An RFID tag has three (3) types such as passive, active and battery assisted passive. In this system, by using a passive RFID, a tag without battery can be read in long range to the RFID reader. It is because by using the radio wave, the reader is not necessary read the tag (plate number) in straight line and it also can be read hundreds at a time [1]. Most RFID contain at least two (2) parts, one is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal and the other part is the antenna for receiving and transmitting the signal [2]. The data transmitted by tag may provide identification or specified information. Other advantage of RFID is it's effective in any environment where tags can be sealed within plastics enclosure eliminating due to expose of chemicals, heat, abrasion, dirt and grease build-up, etc [3].

The system will allow identify registered vehicle in and out of the campus of UMP by recognition of the vehicle plate number. When the reader of RFID can recognize the tag of vehicle plate number, it directly show the vehicle owner details as it is been transmitted in the system and the vehicle barrier quickly open. Then, the registered vehicle of UMP staffs & students can check in and also check out from campus of UMP easily.

1.2 Problem Statement

The problem statements that have lead to this project are:

1) Unauthorized vehicle entering campus of UMP without inspection.
2) Time consuming when frequently check in for each vehicle that passes by the barrier.
3) Numbers of vehicle check in and out of UMP campus are unknown.

The first problem is about unauthorized vehicle entering campus without inspection causes security issue. The problem occur when sometimes vehicle just pass through the entrance of security without stopping by so no authorization process could be done.

Secondly is time consuming when vehicle have to stop for screening process at the entrance when security need to check for identification card of student and staff and also for unauthorized vehicle need to report manually so it consume time for other vehicle queue up at the line of entrance.

University campus always has many visitors so do the community itself. So as the third problem is numbers of vehicle check in and out of the campus are unknown. It is a problem as we cannot really estimate how many vehicle checks in and are the vehicle check out the same day or not for unauthorized vehicle. And also for authorized vehicle, they need to be in campus before 12p.m so the security will record any vehicle coming in late night.

So the objective of the system can help to develop solutions to solve the problem statement.

1.3 Objective

The objectives of this project are:

1) To develop a prototype of RFID systems for vehicle plate recognition.
2) To recognize the vehicle that only registered in UMP will be allowed to enter the campus of UMP.
3) To make statistics on the number of vehicles check in and out of the campus UMP.

1.4 Scope

There will be three (3) scopes that will discussed in details which is:

1) Administration
   - The system managed by administrator.
2) Security Guards
   - The system handled by security guards.
3) User
   - The user of the system is the staffs & students UMP who registered their vehicle in the system.

1.5 Thesis Organization

This thesis consists of six (6) chapters which I described chapter by chapter:

i. **CHAPTER 1: Introduction**
   This chapter briefly contains the whole idea by introduction, problem statement, objective, scopes and thesis organization.

ii. **CHAPTER 2: Literature Review**
   The purpose of this chapter is about the review for the chosen project, divided into two (2) sub-reviews that require a study to get complete information about the project.

iii. **CHAPTER 3: Methodology**
   The content will included all the method, technique or any approach that will be used while designing and implementing the project.

iv. **CHAPTER 4: Implementation**
   The purpose of this chapter is to explain about all the processes involve in the development project.

v. **CHAPTER 5: Result and Discussion**
   This chapter will explain the result and data analysis that had been acquired.

vi. **CHAPTER 6: Conclusion**
   This chapter explains about overall description about the project and its summarization.

CHAPTER 2

2.0 LITERATURE REVIEW

This chapter will review on the existing research based on article, journal or any kind of resources that can give guides on addition of knowledge and information to produce a good system based to the topic proposed before.

This will include on technically what is the system are about and the kind of methodology of the existing systems during the research.

2.1 Radio-Frequency Identification (RFID)

Radio-Frequency Identification that is also known as RFID in general term of Information & Communications Technology (ICT) world. RFID is all widely about a technology that uses radio waves to transfer data from an electronic tag or label to an object, through a reader for purpose of identifying and tracking the object [1]. According to Nemai Chandra Karmakar (2010) states that RFID is a wireless data capturing technique from a tagged item. The RFID tags or

transponders are high-frequency electronic circuits that allow the items to be remotely detected, identified and to be tracked by the position of the items itself [11]. From Patrick J. Sweeney II (2005), he claims that RFID is a very valuable in business and technology tools holds the promise of replacing existing identification technologies like the bar code.

2.1.1 The Arrival of RFID

Based on array technology innovation in 1940s, RFID roots in early military systems. A reflected radio signal identifies a remote object based on the reflection signature from the object from paper of journal "Communication by Means if Reflected Power" 1948.

In early of 196Os, the RFID explode with the theory related to RFID "Theory of Loaded Scatterers" in 1964. RFID related inventions such as "Remotely activated radio frequency powered devices" by Robert Richardson's and "Passive data transmission techniques utilizing radar echoes" by J. H. Vogelman until the first century opens with the smallest microwave tags built using at a minimum two components; a single custom CMOS integrated circuit and an antenna. Tag was creating as sticky labels, easy attached to windshields and for objects to be managed well. The use of electronic for collection toll had become popular systems to applied with RFID system especially in United States and had develop to other country as well.

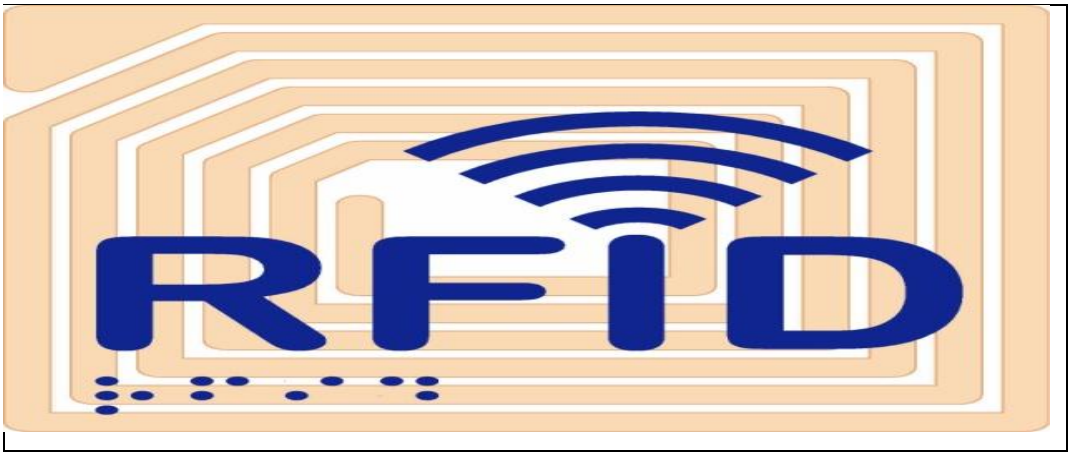


Figure 2.1a – Radio Frequency Identification (RFID)

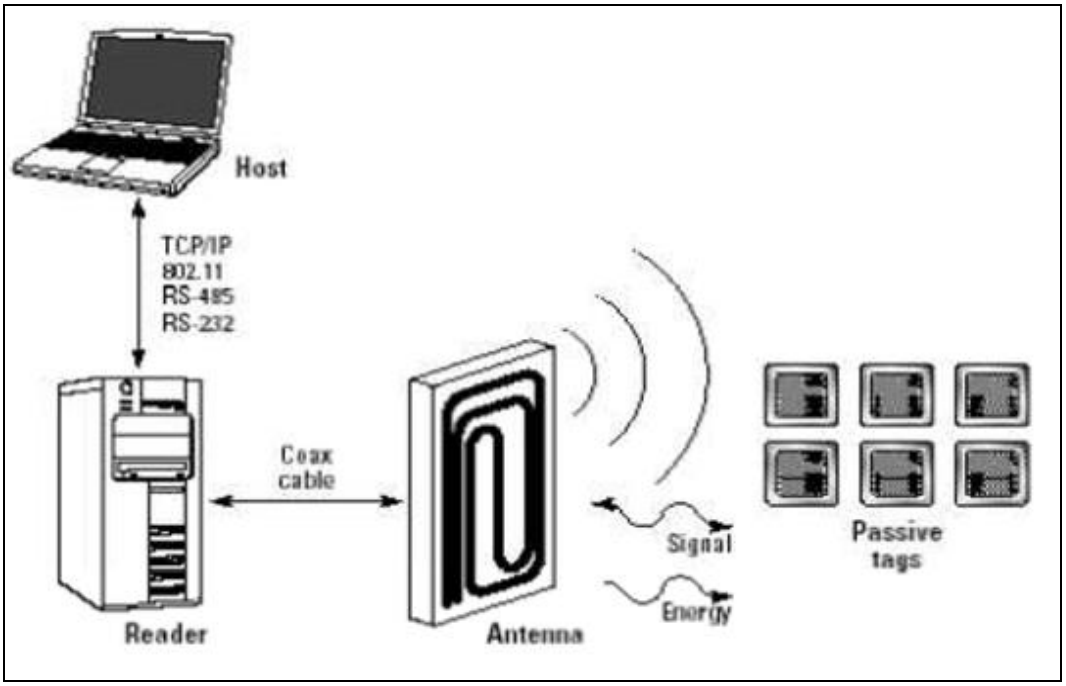


Figure 2.1b – Process of RFID

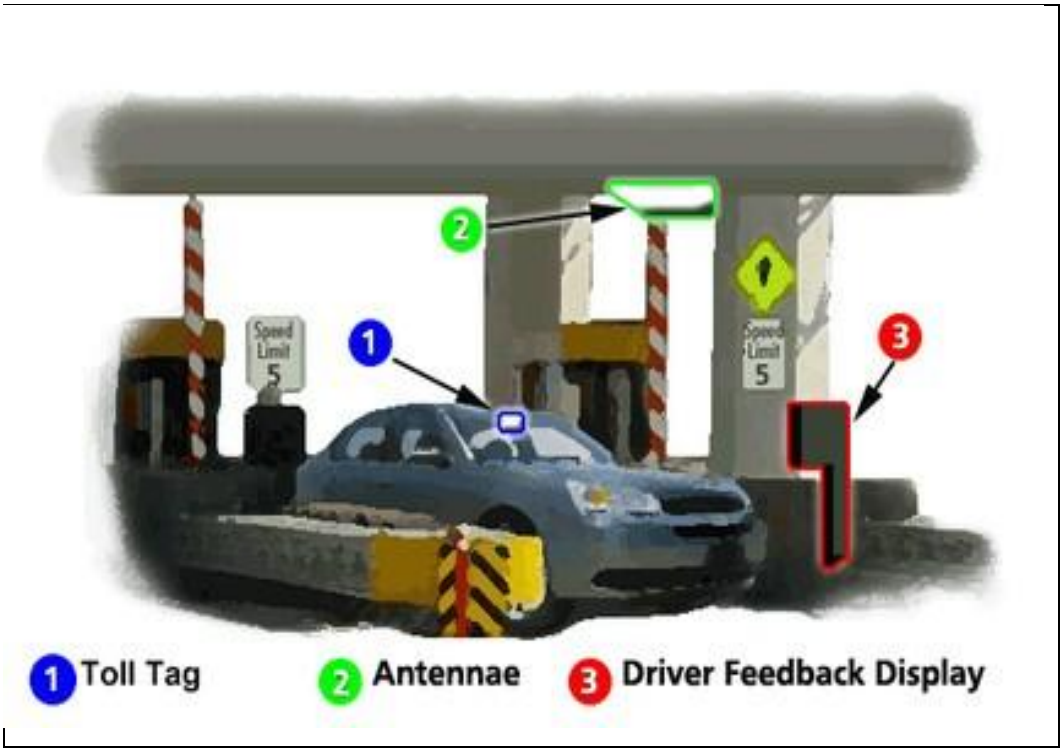


Figure 2.1c – RFID mostly applied for toll system

2.2 RFID Tag

There are 3 types of tag has been produced in name of RFID tag. Well-known tags are passive, active and battery assisted passive types. Most RFID tag contains at least two (2) parts that is integrated circuit and the antenna. The circuit is for storing and processing information, modulate and demodulate a radio-frequency (RF) signal while the antenna functions to receive and transmit the signal [1]. George Roussos (2008) issued that passive tag of RFID is a tag that carry no battery at all which is whole system is depends on the reader for its energy supply [10]. As agreed with Patrick J. Sweeney II (2005), passive tag read by the reader in the close presence. While active tag communicates powers by battery. The active tag will always broadcasts its signal and the battery supplies power to both the tags and the transmitter [11]. Also state in the research of Nemai Chandra Karmakar (2010), semi-passive tag are also called battery assisted tags (BATs). Generally the tag has on-board power supply to provide power to the tags to keep it alive but it doesn't carry any transmitter.

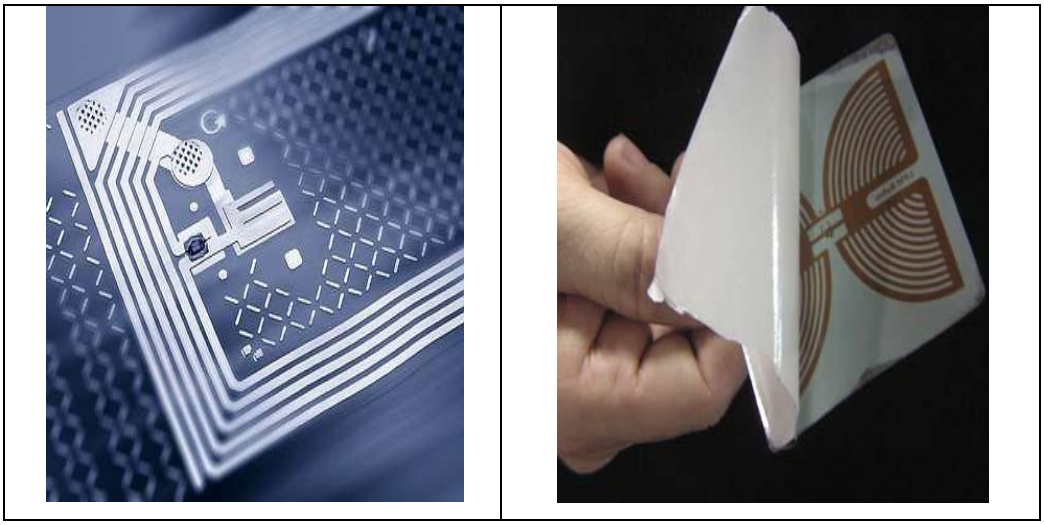


Figure 2.2a – RFID Tag

2.2.1 Passive Tag

A passive tag operates power from the reader, not contain a power itself. To conducts the circuitry, the tags relies on electromagnetic power obtained from the RFID antenna. The design of passive tag could be simpler and less expensive. Since passive tag depend power from the reader and antenna, the tag comes for downside as their range is extremely limited. The tag must be close proximity to the reader and antenna in order to have sufficient power to transmit signal for the data.

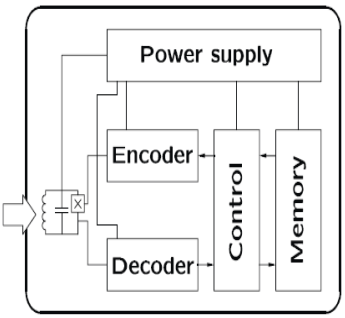
Classification	Performance Data
Passive Tag 	• Known as 'pure passive', 'reflective' or 'beam powered' that operates power from the reader • The reader sends electromagnetic waves that induce current in the tag's antenna, the tag reflects the RF signal transmitted and adds information by modulating the reflected signal

Table 2.2a – Passive Tag

2.2.2 Semi-active (Semi-passive) Tag

Semi-active tag uses an internal battery to support power for circuit that is internal to then tag itself. The circuit includes sensors monitoring environmental conditions such as temperature and humidity. The sensors are also powers to detect vibration and movement. The semi-active tag typically used to monitor the possibility of damage or unauthorized movement during transport or storage.

For semi-passive tag, it relies on electromagnetic field power received from the antenna. It conserved internal power for battery life. Power supply from the internal is the most important elements for semi active (semi-passive) tags.

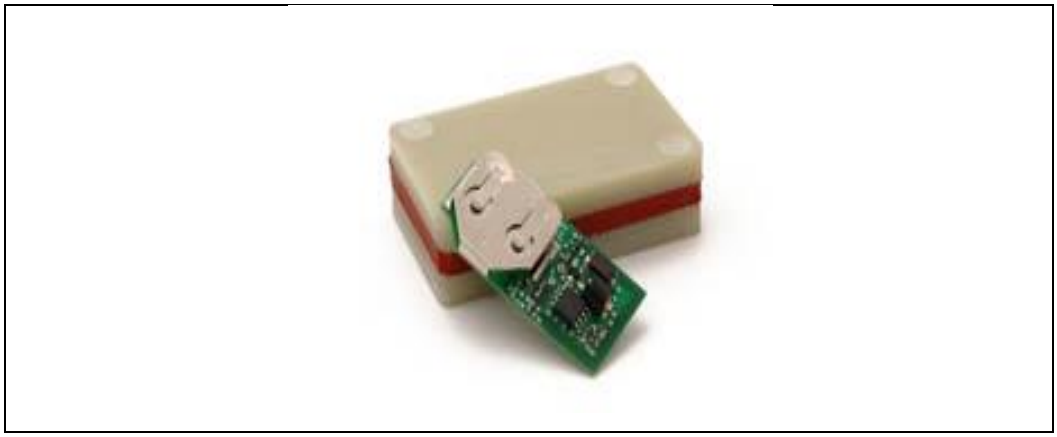


Figure 2.2b – Semi-active Tag

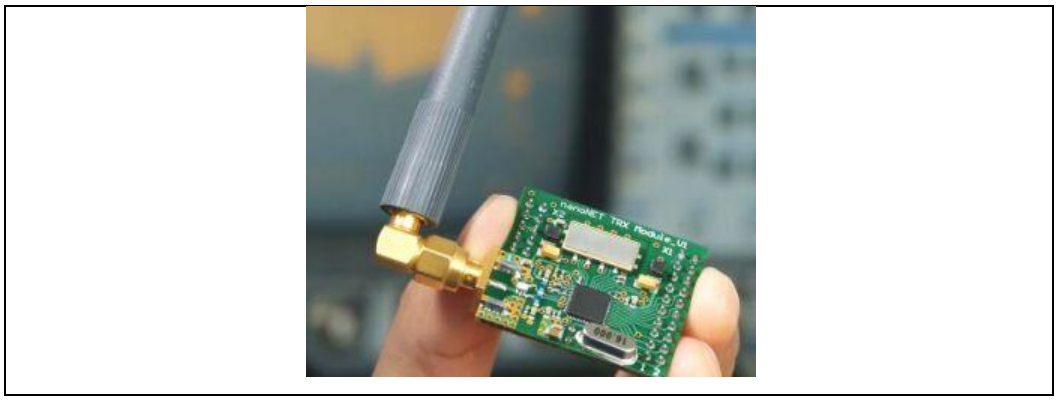


Figure 2.2c – Semi-passive Tag

2.2.3 Active Tag

Active tag differs from the passive tag as it contains its own power source. The power usually comes in the form of a small battery. The battery power both the tag internal circuit and also the antenna. Active tag are more larger and more costly than passive tag.

This type of tag is known as transmitter/receiver (or transponder) when the active transmitter are being read in long range by the reader.

Figure 2.2d – Active Tag

2.3 RFID Reader

RFID readers have evolved and are now frequently wireless handheld units that enable the user to roam through a warehouse, capturing RFID data wherever RFID tags are found. Some readers are adapters that add RFID reader capability to a PDA that can snap into a cradle. Readers are growing more radio frequencies sensitive, and more capable of processing, as well as just collecting, RFID data.

Reader generates the signal that goes out through the antenna into space and listens for the tag's response. Besides that the reader also receives analog waves and then turns them into bits of digital information. Each reader is connected to one or more antennas and its function practically as bridge between the application software and the antenna that radiates radio waves towards the tags.

In simple RFID systems, the energy of RFID reader functioned as an on-off switch. In more sophisticated systems, the reader's RF signal able to provide the tag, instructions to read or write memory that the tag contains, and even passwords.

Figure 2.3a – RFID Reader

Components	Description
Transmitter	• Used to transmit AC power and the clock cycle with the antenna and tags in its zone of circuit. • Reader send signal to environment and receiving tag will response back connect with the antenna.
Receiver	• Receive analog signals from the tag via the antenna. • Send the signal to reader to be converted to its equivalent digital.
Microprocessor	• Implement the reader protocol for communication with compatible tags. • Perform decoding and error checking of the analogue signal from the receiver.
Memory	• Store data stored in the tag to be read by reader and antenna.
Input/output channel	• External sensor for reader to read the tag.

Table 2.3a – RFID Reader Components

2.4 RFID Antenna

The RFID physical layer consist antennas used to couple the reader to the tag so that information can be transferred between the frequencies at which it oscillates and the strength or power of those oscillations.

Most RFID systems use unlicensed spectrum, which is a specific part of the spectrum set aside for use without a radio license. Popular bands are the low-frequency (LF) band at 125 - 134.2 KHz, the high-frequency (HF) band at 13.56MHz, the ultrahigh-frequency (UHF) band a 915MHz and the industrial, scientific, and medical (ISM) band at 2.4GHz.[2]

The energy that is radiated from an antenna is dividing into two parts:

a. the near field-part of radiation that is within a small number of wavelengths of the antenna
b. the far field- the energy that is radiated beyond the near field

The low-frequency (LF) and high-frequency (HF) RFID systems are operate in the near field while ultrahigh-frequency (UHF) and industrial, scientific, and medical (ISM) RFID systems operate in the far field.

The larger the antenna on the reader and the tag, the better an RFID system will work because large antennas are generally more efficient at transmitting and receiving radio power than are small antennas. Thus, a large antenna on the reader means that more power can be sent to the RFID tag and more of the tag's emitted energy can be collected and analysed. A large antenna on the tag means that more of the power can be collected and used to power the chip. Likewise, a large antenna on the chip means that more power can be transmitted back to the reader.

Figure 2.4a – RFID Antenna

Characteristics	Description
Impedance	• The resistance of an electrical component to alternating current. • Measured in ohms.
Polarization	• Move to wave. • Best power between two antenna.
Bandwidth	• Different bandwidth for different antenna size and configuration.
Appearance	• Antenna fit in the décor of surroundings.

Table 2.4a – RFID Antenna Charateristics

2.5 Radio Wave

From the author of Basic Concepts in RFID Technology by Richard Moscatiello states that the radio waves that function are a kind of electromagnetic waves so do with the light and x-rays. The number of waves that occur in one second is known as the frequency and it is measured in Hertz. One Hertz is equal to one wave oscillation per second.

The channel frequency over an RFID system communicates data called a carrier wave. It used to carry data RFID tag antennae tune to resonate only to the specified band carrier frequencies. RFID tag is able to absorb and reflect energy back to the source [4].

The reader generates a magnetic alternating field in the radio frequency range. If the circuit moved into the vicinity of the magnetic field, the energy from alternating field can be induced in the resonant circuit via its coils based on Faraday's Law. The current flows in the resonant circuit and it acts against the external magnetic alternating field. This effect of small change in voltage drop across the transmitter's generator coil and leads to a weakening of the measureable field strength.

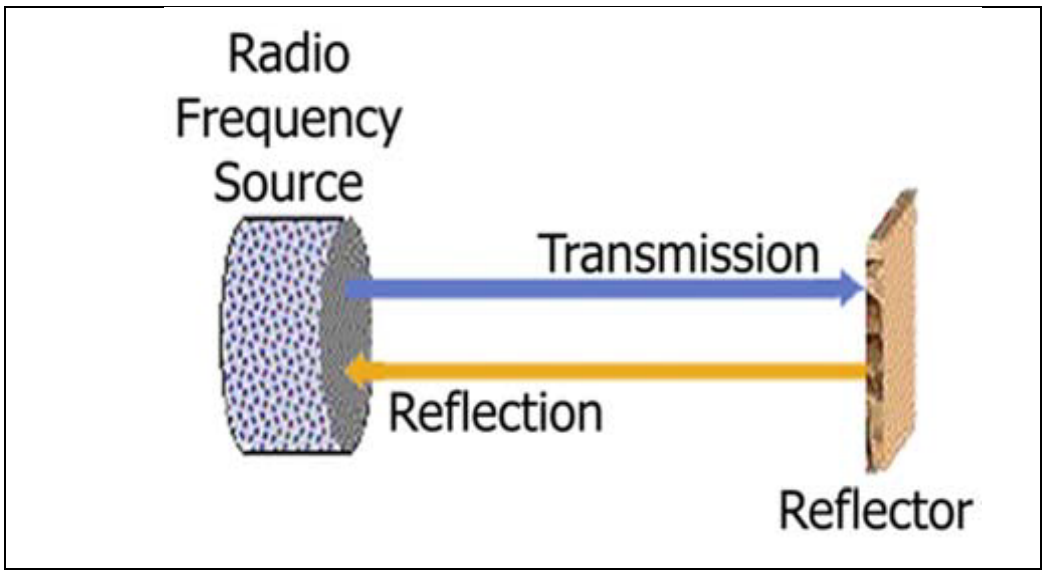


Figure 2.5a – Radio Frequency Transmission & Reflection

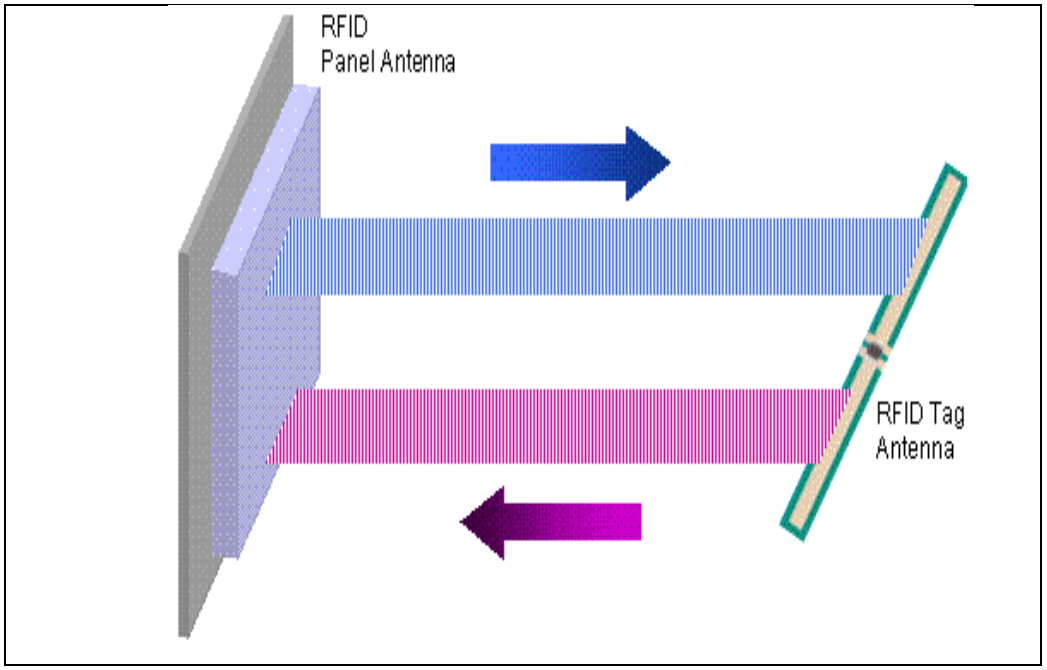


Figure 2.5b – Radio Frequency Reader & Tag Antenna

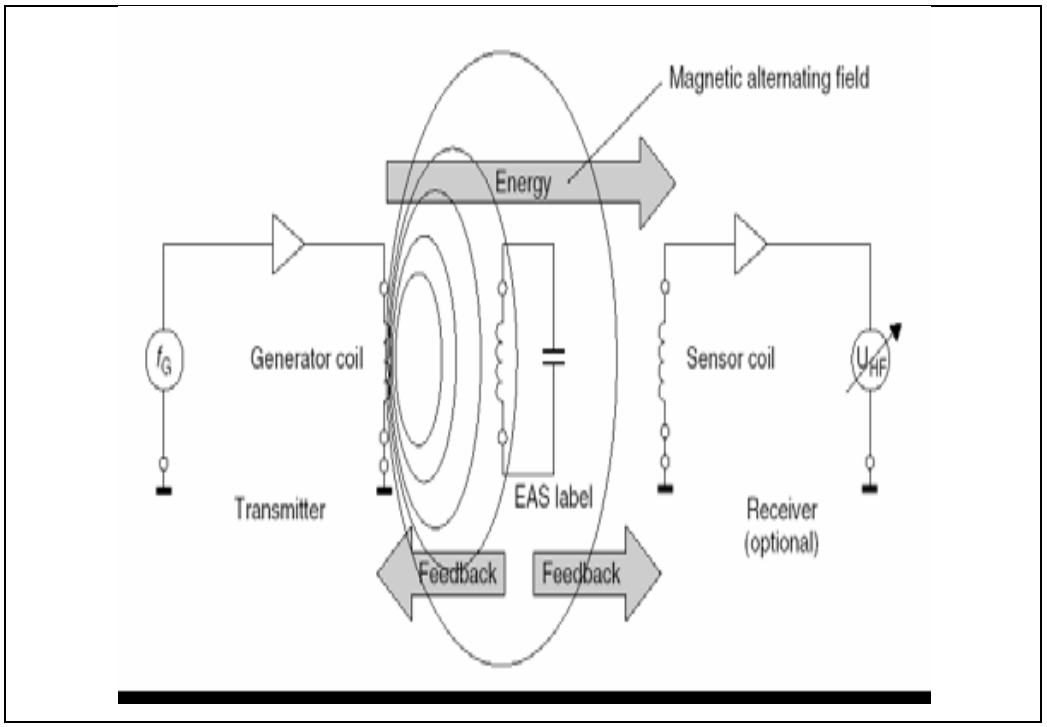


Figure 2.5c – Radio Frequency Energy